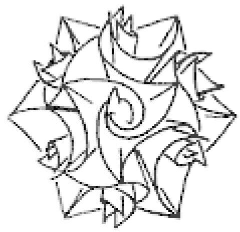
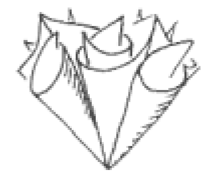
Curler Units

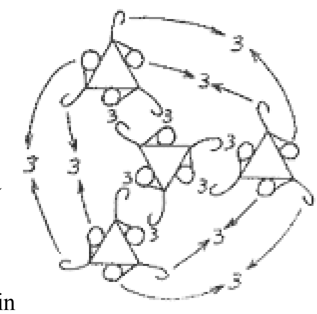


Use small squares (max 7x7 cm) of stiff paper. Ordinary origami paper is too thin, but photocopy paper works very well. Make a waterbomb base and curl each of the flaps into a cone. As shown in the top view, all flaps are curled clockwise (left-handed folders may find it easier to work from a mirror image of these diagrams - sorry!)



The paper should stay curled up as indicated (that's why you need heavier paper) so initially you'll need roll up the flaps a bit tighter than shown in the drawings as the curls will open out slightly when you let go.

To assemble the units, gently ease one curl inside another curl. You can combine 2, 3, 4, 5... curls this way to create many-armed vortexes. You can think of a 3-vortex as a triangle, a 4-vortex is a square and so on. Combining the curls of a number of these units into vortexes you can make several different polyhedra.



The final drawing (below) shows a cuboctahedron. For this, you'll need 12 units. Join 3 units in a 3-vortex. Join the curls along the 3 edges of this "triangle" and add more units to make each of these linked curls into a 4-vortex.

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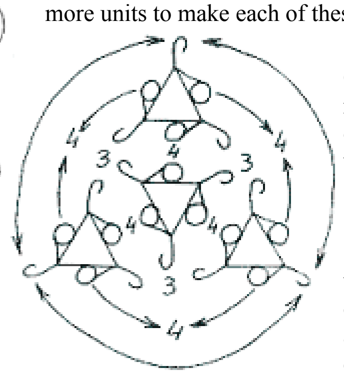
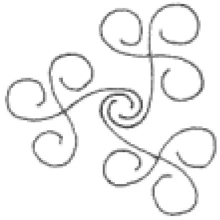


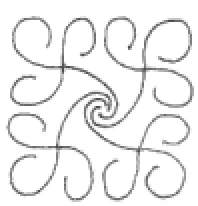
Continue building the cuboctahedron until you run out of units. Take care never to put more than one curl of a unit in the same vortex. If you lose track of the curls, just remember that each square is surrounded by 4 triangles and each triangle is surrounded by 3 squares.

If this explanation doesn't work for you, try the diagrams at the right. First you join 3 units in a sub-assembly (which we simplify to a "curly triangle") and then join 4 of these sub-assemblies as indicated in the big drawing on the right. The arrows and numbers indicate how many curls are joined at each position.

Further experiments : To make an icosidodecahedron (which consists of 3-vortexes and 5-vortexes) you'll need 30 units. Construction is similar to the cuboctahedron but here each pentagon is surrounded by 5 triangles and each triangle is surrounded by 3 pentagons. When you make constructions with this many units, it's a good idea to make the curls a little tighter (and looser if you use less units, though such sparse assemblies are not as attractive and stable. The 6-unit octahedron, for instance, is rather fragile because the curls are overstretched).

You can construct other polyhedra this way (obvious candidates are the (small) rhombicuboctahedron and the (small) rhombicosidodecahedron) but only if there are exactly 4 faces meeting at every corner (vertex) of the polyhedron. This is because the waterbomb base has exactly 4 flaps !





If you really want to make polyhedra with 3 faces meeting at the corners you could put 2 curls of a unit in the same vortex or tuck away the fourth flap inside the waterbomb base or just leave 1 curl unconnected (if there is enough room in the vortex) but none of these solutions are very elegant.

To make the icosahedron (which has 5 faces meeting at each corner) we just leave a hole where the 5th face should go. As it's quite tricky to assemble, here's another diagram to help you. You use the same 4 sub-assemblies as for the cuboctahedron, but put them Figure 1 together in a slightly different way. The resulting figure is strangely irregular : it looks a bit like an icosahedron but not quite. The "holes" are pulled further apart than the "filled" triangular faces so the modular only has tetrahedral symmetry (and is in fact closely related to the snub tetrahedron).

Here you see a strange property of these assemblies : the curls act as tiny rubber bands pulling the units together, so that the structure settles at an equilibrium position where the tension in all the curls is minimal (which is usually, but not always, quite a regular configuration).

For the adventurous : A 4-unit tetrahedron is just possible. 3 curls of each unit are joined in 2-vortexes along the tetrahedron's edges, the fourth is unconnected. Or try the 18-unit deltoidal icositetrahedron. All curls are joined in 3-vortexes and those corners of the icositetrahedron where 3 faces meet are left as holes. That's why we only need 18 units instead of 26. Make a 24-unit snub cube, either leaving the 6 square faces as holes or leaving 8 triangular faces as holes (choose those triangles not sharing any edges with the squares)

I haven't experimented with colours : I prefer working in white as the shadows on the curved surfaces show up better. If you want to have a go you could try folding your waterbomb bases from pre-coloured squares with a light-dark pattern as shown in the figures on the right. The cuboctahedron will then have triangular vortexes in one colour and square vortexes in the other (this works for the icosidodecahedron as well). If you don't like using pre-printed patterns, get duo paper, blintz it and then fold the blintzed triangles to create the colour pattern you want to experiment with.